Body mass index and its relationship to mental disorders in the Mexican Adolescent Mental Health Survey

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Abstract

Objective. To assess the association between body mass index (BMI) and the prevalence of psychiatric disorders among Mexico City adolescents. **Material and Methods**. Household survey of 3 005 adolescents aged 12 to 17 residing in Mexico City in 2005 (response rate = 71%). Face to face interviews were carried out in the homes of participants with informed consent from a parent and/or legal guardian and the assent of the adolescent was obtained. Logistic regression analyses were performed. **Results**. We only found an association between extremely low BMI and impulse control disorders. Elevated BMI was associated with impulse control disorders only among females. Specific impulse control disorders associated with low BMI included intermittent explosive disorder and conduct disorder. Only intermittent explosive disorder was associated with elevated BMI. **Conclusion.** Among Mexican adolescents, those with extremely high or extremely low BMI were more likely to have impulse control disorders than were adolescents with normal BMI.

Keywords: obesity; adolescent; race/ethnicity; public health; mental health; Mexico

Resumen

Objetivo. Evaluar la asociación entre el índice de masa corporal (IMC) y la prevalencia de trastornos psiquiátricos en adolescentes de la Ciudad de México. **Material y métodos**. 3 005 adolescentes entre 12 y 17 años fueron entrevistados en 2005 (tasa de respuesta =71%). Las entrevistas cara a cara se hicieron en los hogares de los participantes seleccionados después del consentimiento de los padres o tutores. Se utilizó regresión logística. **Resultados**. Sólo se encontró asociación entre IMC extremadamente bajo y trastornos de control de impulsos. El IMC elevado estuvo asociado con trastornos de control de impulsos sólo en las mujeres. Los trastornos de control de impulsos específicamente relacionados con bajo IMC incluyen el trastorno explosivo intermitente y el trastorno de conducta. El alto IMC estuvo relacionado únicamente con el trastorno explosivo intermitente. **Conclusión**. Entre los adolescentes mexicanos, es más probable que aquellos con IMC extremadamente alto o bajo presenten trastornos de control de impulsos que aquellos con IMC normal.

Palabras clave: obesidad; adolescente; raza; salud pública; salud mental; México

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Elevated body mass index (BMI) ranks as the second leading risk factor for mortality and disability adjusted life-years in Mexico today [1] and contributes to the increasing incidence of ischemic heart disease and diabetes which together accounted for approximately 1 of every 4 deaths among Mexicans in 2004. The most recent data in Mexico suggest a high prevalence of overweight and obesity: overweight: 21.2% in males and 23.3% in females and obesity: 10% males and 9.2% females.[2]

High BMI may also have mental health consequences. Elevated BMI has been linked to depression among adults in cross sectional studies.[3,4] and to the subsequent development of depression in prospective studies of adolescents and young adults in the United States.[5] Recent research among adults has extended the BMI mental health relationship to include psychiatric disorders other than depression.[6-8] Modest associations were found between adult BMI and not only mood but also anxiety disorders in the World Mental Health surveys,[8] an association accounted for by the disproportionate prevalence of these disorders among extremely obese females. The relationship between BMI and specific psychiatric disorders appears to vary by country; in the adult Mexican cohort, for example, only anxiety disorders were associated with BMI. [8]

Although several common mental disorders have an early age of onset [9] and several commonly manifest for the first time during adolescence, few data are available on the relationship between BMI and mental disorders among adolescents. Studies of BMI that have used large, representative samples of adolescents[10-14] have tended to focus on a limited number of specific mental disorders, most often depression or anxiety, have relied on clinical samples,[15,16] or on measures of general distress[12,17] rather than clinical diagnostic categories. In addition, the majority of studies of BMI and mental illness have focused on the relation of high (rather than low) BMI and mental illness, even though work among adults have suggested a robust *inverse* association between BMI and completed suicide.[18-20]

The current study extends prior work by examining the relationship between high and low BMI and a large number of specific psychiatric disorders among a large sample of adolescents in Mexico. Specifically, we report on associations between BMI and the 12-month prevalence of DSM-IV psychiatric disorders among adolescents aged 12 to 17 living in one of the largest metropolis in the world, the Mexico City Metropolitan Area.

Material and Methods

Participants

Details about this sample are presented elsewhere.[21] The survey was designed to be representative of the 1 834 661 adolescents aged 12 to 17 that are permanent residents of private housing units in the Mexico City Metropolitan Area. The final sample included 3 005 adolescent respondents selected from a stratified multistage area probability sample. In all strata, the primary sampling units were census count areas, or groups of them, similar to US census tracts. Secondary sampling units were city blocks (or groups of them) selected with probability proportional to size. All households within these city block units with adolescents aged 12 to 17 were selected. The response rate of eligible respondents was 71%.

Procedures

Face to face interviews were carried out in the homes of the selected participants in 2005. A verbal and written explanation of the study was given to both parents and adolescents. Interviews were administered only to those participants for whom a signed informed consent from a parent and/or legal guardian and the assent of the adolescent was obtained. The adolescent interview took approximately two and a half hours to administer. All study participants were left contact information for institutions were they could seek services should they wish to do so. A total of 3 005 adolescents completed the survey (response rate = 71%). The Human Subjects Committee of the Mexican National Institute of Psychiatry approved the recruitment, consent and field procedures.

Diagnostic assessment

The Mexican Adolescent Mental Health Survey utilized the computer assisted (CAPI) version of the World Mental Health version of the Adolescent Composite International Diagnostic Interview (WMH-CIDI-A) as the diagnostic tool. Psychiatric diagnosis was evaluated with the fully structured, computer assisted, World Mental Health adolescent version of the Composite International Diagnostic Interview (WMH-CIDI-A) the development of which is described elsewhere.[22] The WMH-CIDI-A is a downward extension of the adult ver-

sion WMH-CIDI 3.0 used in the M-NCS; the adolescent version has been validated in a U.S. sample[23] while the adult version has been validated in diverse countries and cultures.[24]

We report on the associations between BMI and 12-month prevalence of psychiatric disorders, classified according to the diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV).[25] All disorders used organic exclusions rules as well as hierarchy definitions in order to avoid double counting of disorders in the same person. The disorders are grouped into the following categories:

1. Mood disorders: major depressive episode, bipolar I and II disorder (which we group as "bipolar broad") and dysthymia with hierarchy;
2. Anxiety disorders: specific phobia, social phobia, panic disorder, agoraphobia without panic disorder, separation anxiety disorder, generalized anxiety disorder and posttraumatic stress disorder;
3. Substance disorders: alcohol and drug abuse and alcohol and drug abuse with dependence;
4. Impulse-control disorders: oppositional-defiant disorder, conduct disorder, attention deficit/hyperactivity disorder, and intermittent explosive disorder.

Assessment of serious mental disorder

Disorder severity is defined as severe[26] if any one of the following conditions is met: the presence of bipolar I disorder, substance dependence with a physiological dependence syndrome, a suicide attempt in conjunction with any other disorder, or reporting at least two areas of role functioning with severe role impairment due to a mental disorder as measured by the disorder-specific Sheehan Disability Scales.[27]

Obesity and underweight

Height and weight was obtained by self-report. Body mass index (BMI) was calculated by self-reported weight in kilograms divided by self-reported height in meters squared. We followed the criteria for classifying the adolescents BMIs accordingly to the CDC recommendations, that is a BMI age- and sex-specific, often referred to as BMI-for-age (http://www.cdc.gov/nccdphp/dnpa/bmi/childrens_BMI/about_childrens_BMI.htm). Underweight was defined for those with a BMI less than the 5th percentile, normal weight as those from the 5th percentile to less than the 85th percentile, and overweight as those above the 85th percentile.

Assessment of socio-demographic correlates

General information was collected on sex, age and family constellation. Family constellation was categorized as living with both parents or not living with both parents. Participants were considered students if currently enrolled as a student and drop outs if not currently enrolled as a student. Adolescents were asked whether they worked during the school year, whether they were ever married and whether they had children. All three conditions represent an additional burden not typical of the adolescent stage. Having answered affirmatively for any of the three, the participant was categorized as having adolescent burden. The adolescents were asked about the educational attainment of each of their parents which was then categorized as none/primary (six or less years of education), secondary (7-9 years of education), high school (10-12 years of education) or college (13 or more years of education); the score of the parent with the highest level of education was used. Parents reported family income was categorized into tertiles. We also included information on current (last 12-months) smoking (yes/no), non-medical diet in the last 12-months (yes/no) and frequency of heavy and light exercise [three categories from tertiles, never-rarely (lower tertile), a few (middle) and frequently (upper tertile)].

Analysis

The data were obtained from a stratified multistage sample and were thus subsequently weighted to adjust for differential probabilities of selection and non-response. Post-stratification to the total Mexico City Metropolitan Area adolescent population according to the year 2000 Census in the target age and sex range was also performed.

As a result of this complex sample design and weighting, estimates of standard errors for proportions were obtained by the Taylor series linearization method using the SUDAAN software.* Logistic regression analysis was performed to study demographic correlates.[28] Estimates of standard errors of Odds Ratio (OR) from logistic regression coefficients were also obtained by SUDAAN, and 95% Confidence Intervals (CI) have been adjusted to design effects. Multivariate tests are based on Wald χ^2 tests computed from design-adjusted coefficient variance-covariance matrices, allowing us

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to test the global hypothesis that extremes in BMI are related to specific psychiatric diagnoses and groups of diagnoses. Statistical significance was based on two sided design based tests evaluated at the .05 level of significance.

Results

The (weighted) sample was 50.1% females, 50.7% between 15-17 years of age, 81.2% were currently at-tending school, and 63.3% came from families where their parents had a junior high education or less. No differences were found in the distribution of BMI ac-cording to measures of parental education or income (Table I). Those living with parents were more likely to be underweight, and those under non-medical diets more likely to be overweight.

For the total sample, we found an increase in the likelihood of impulse control disorders among adolescents with extreme BMI (i.e., high or low

Table I

Socio-demographic distribution of the sample according to Body Mass Index among 3 005 Adolescents in Mexico City (2005)

Variable (n-unweighted)	Underweight		Normal weight		Overweight		χ^2_{2-6} (p)
	%	%(S.E.)	%	%(S.E.)	%	%(S.E.)	
Site							1.35 (0.273)
State of Mexico (1 507)	5.9%	0.8%	79.1%	0.9%	15.0%	0.6%	
Mexico City (1 498)	4.4%	0.6%	81.0%	1.1%	14.6%	0.9%	
Exercise							0.32 (0.862)
Never-rarely (lower tertile) (988)	5.5%	0.5%	79.1%	1.2%	15.5%	1.2%	
A few (middle) (1 023)	5.2%	0.9%	79.7%	1.3%	15.1%	1.0%	
Frequently (upper tertile) (994)	4.9%	0.6%	81.3%	1.6%	13.8%	1.5%	
Living withparents							3.41 (0.045)
No (One/none) (1 025)	4.6%	0.3%	79.4%	0.9%	16.0%	0.9%	
Yes (both) (1 980)	6.3%	1.1%	81.2%	1.2%	12.5%	1.0%	
Current student							0.68 (0.512)
No (479)	4.2%	1.1%	82.4%	2.3%	13.4%	1.7%	
Yes (2 526)	5.4%	0.5%	79.5%	0.8%	15.1%	0.7%	
Adolescent burden							0.45 (0.642)
No (303)	5.0%	0.5%	80.2%	0.8%	14.8%	0.6%	
Yes (2 702)	6.3%	1.6%	79.1%	2.9%	14.6%	2.2%	
Parents education							1.47 (0.221)
None/Primary (776)	5.8%	0.9%	81.2%	1.6%	13.0%	1.1%	
Secondary (7-9 years) (1 133)	5.9%	0.7%	77.9%	1.4%	16.2%	1.3%	
High School(10-12 years) (696)	4.0%	1.0%	80.4%	1.4%	15.6%	1.3%	
College (13+ years) (399)	3.9%	1.3%	83.0%	2.2%	13.1%	1.8%	
Parents income							1.89 (0.113)
Low (1107)	5.6%	0.9%	81.4%	1.1%	13.0%	0.9%	
Low-Average (676)	5.6%	0.8%	77.9%	1.5%	16.4%	1.5%	
High-Average (470)	4.2%	0.6%	77.2%	2.5%	18.7%	2.5%	
High (752)	4.7%	0.7%	81.7%	1.6%	13.6%	1.5%	
Used tobacco 12 months							0.14 (0.867)
No (2 781)	5.2%	0.5%	79.9%	0.7%	14.9%	0.6%	
Yes (224)	5.1%	2.0%	81.4%	2.8%	13.5%	2.5%	
Non-medical diet last 12 months							8.68 (0.001)
No (2 898)	5.2%	0.5%	80.5%	0.8%	14.3%	0.6%	
Yes (107)	3.0%	1.3%	68.3%	3.7%	28.7%	4.0%	

Ns are unweighted; % are weighted. BMI calculated among children of the same sex and age
Underweight less than the 5th percentile, Healthy weight 5th percentile to less than the 85th percentile and overweight >=85th percentile

BMI compared to normal BMI, *p*<0.001) (Table II). The magnitude of the association between low BMI and impulse control disorders was similar for males (*OR*=1.7) and females (*OR*=1.6), though neither sex stratified association was significant at the *p*<0.05 level. The increased prevalence of impulse control disorders among underweight adolescents was not due to a relationship with bulimia or anorexia, as the inclusion of both disorders in the model did not change the association between low BMI and impulse control disorders (data not shown). Female but not male adolescents with high BMI were more likely to have impulse control disorders (*OR*= 1.9 among females; *p*= 0.090 for the interaction). Among males,

but not females, those with underweight had increase odds ratio of any severe disorder (*OR*= 2.3; *p*= 0.069 for the interaction).

The association between extreme BMI and impulse control disorders among our cohort was attributable to a disproportionate prevalence of conduct disorder among adolescents with low BMI and intermittent explosive disorder among adolescents with high BMI (*OR*=2.7 and 1.5, respectively; Table III). As a group, impulse control disorders were associated with high BMI only among females. Sensitivity analyses in the total sample for adolescents with BMI over the 95th percentile (obese) were similar to results presented for adolescents with BMI above the 85th percentile.

Table II

ASSOCIATIONS BETWEEN BODY MASS INDEX AND 12-MONTH CIDI/DSM-IV DISORDERS, ADJUSTED BY DEMOGRAPHICS AND TYPE OF DISORDER, TOTAL AND BY GENDER, AMONG 3 005 ADOLESCENTS IN MEXICO CITY (2005)

Disorder	Underweight		Normal weight		Overweight	
	OR*	(95% CI)	OR*	(95% CI)	OR*	(95% CI)
Total						
Any anxiety disorder[§]	0.8	(0.6-1.1)			1.1	(0.9-1.3)
Any mood disorder[§]	0.7	(0.3-1.8)	1.0	--	0.6	(0.3-1.2)
Any impulse-control disorder[§]	1.7	(0.9-3.0)	1.0	--	1.5	(1.1-1.9) [‡]
Any substance use disorder[§]	0.7	(0.1-3.7)	1.0	--	0.5	(0.2-1.3)
Any	1.0	(0.6-1.5)	1.0	--	1.1	(0.9-1.4)
Any severe disorder	1.3	(0.5-2.8)	1.0	--	1.2	(0.7-2.0)
Males						
Any anxiety disorder[§]	0.7	(0.4-1.5)	1.0	--	1.2	(0.9-1.7)
Any mood disorder[§]	1.0	(0.3-3.7)	1.0	--	0.5	(0.2-1.4)
Any impulse-control disorder[§]	1.7	(0.8-3.5)	1.0	--	1.1	(0.7-1.6)
Any substance use disorder[§]	0.9	(0.1-7.2)	1.0	--	0.8	(0.3-2.4)
Any	0.9	(0.5-1.6)	1.0	--	1.1	(0.8-1.4)
Any severe disorder	2.3	(1.1-4.9) [‡]	1.0	--	0.7	(0.3-1.5)
Females						
Any anxiety disorder[§]	0.8	(0.5-1.4)	1.0	--	0.9	(0.7-1.2)
Any mood disorder[§]	0.6	(0.2-2.1)	1.0	--	0.7	(0.4-1.4)
Any impulse-control disorder[§]	1.6	(0.7-3.5)	1.0	--	1.9	(1.3-2.8) [‡]
Any substance use disorder[§]	0.5	(0.1-5.0)	1.0	--	0.2	(0.0-1.2)
Any	1.0	(0.7-1.6)	1.0	--	1.1	(0.8-1.5)
Any severe disorder	0.8	(0.3-2.2)	1.0	--	1.4	(0.8-2.5)

* Odds ratios (*OR*) from logistic regression coefficients. The 95% confidence interval (95% *CI*) were obtained using the Taylor series linearization method.
§ Based on separate multivariate logistic regression equations for each group of psychiatric disorder controlling for baseline demographics from Table I and all other groups of disorders
‡ Significant at *p*<=0.05

Table III
ASSOCIATIONS BETWEEN BODY MASS INDEX AND 12-MONTH CIDI/DSM-IV IMPULSE CONTROL DISORDERS
AMONG 3 005 ADOLESCENTS IN MEXICO CITY (2005), ADJUSTED BY DEMOGRAPHICS VARIABLES

Disorder	Underweight		Normal weight		Overweight	
	OR*	(95% CI)	OR*	(95% CI)	OR*	(95% CI)
Total						
Impulse-control				--		
Intermittent explosive disorder	1.5	(0.8-2.8)	1.0	--	1.5	(1.1-2.0)‡
Oppositional-defiant disorder	0.6	(0.3-1.1)	1.0	--	1.3	(0.8-2.2)
Conduct disorder	2.7	(1.0-7.5)	1.0	--	0.8	(0.4-1.6)
Attention-deficit/hyperactivity disorder	1.0	(0.2-5.8)	1.0	--	0.9	(0.4-2.1)
Males						
Impulse-control				--		
Intermittent explosive disorder	1.2	(0.5-3.1)	1.0	--	1.4	(0.9-2.1)
Oppositional-defiant disorder	1.7	(0.8-3.9)	1.0	--	0.7	(0.3-2.2)
Conduct disorder	3.0	(0.9-2.8)	1.0	--	1.0	(0.4-2.8)
Attention-deficit/hyperactivity disorder	1.4	(0.1-15.2)	1.0	--	0.3	(0.3-3.0)
Females						
Impulse-control				--		
Intermittent explosive disorder	1.8	(0.7-4.5)	1.0	--	1.7	(1.0-2.7)‡
Oppositional-defiant disorder	0.1	(0.0-0.6)‡	1.0	--	1.5	(0.8-2.9)
Conduct disorder	2.1	(0.4-11.3)	1.0	--	0.6	(0.2-1.5)
Attention-deficit/hyperactivity disorder	0.5	(0.1-5.1)	1.0	--	1.4	(0.5-3.5)

* Odds ratios (*OR*) from logistic regression coefficients. The 95% confidence interval (95% *CI*) were obtained using the Taylor series linearization method.
 Based on separate multivariate logistic regression equations for each psychiatric disorder controlling for baseline demographics from Table 1
‡ Significant at *p*<=0.05

Discussion

Impulse control disorders, but not disorders of mood, anxiety or substance use, were disproportionately present among Mexican adolescents with extreme BMI. This result held even after controlling for comorbid psychiatric illness, including eating disorders, and several demographic characteristics. Our findings of an association between elevated BMI and impulse control disorders was primarily driven by the relationship among females, a finding that is consistent with a study of young adults followed from age 19 to 40 that found a similar gender based relationship between elevated BMI and aggressive personality traits.[29] Others studies that reported an association between impulse control disorders and elevated BMI did not find that the relationship was confined to females.[14,30] Among adolescents in the US, for example, chronic obesity was associated with oppositional defiant disorder[14]

and adolescent conduct disorder predicted elevated BMI nine years later.[30]

Consistent with some[13,30] but not other[31] studies we did not find an association between disorders of mood, anxiety or substance use among adolescents with either high or low BMI. Findings from other studies have, however, been inconsistent. For example, some studies have reported a positive association of elevated BMI and depression among females only,[10] others that obesity at the age of 14 years predicted depressive scores at the age of 31 years in both sexes,[32] others that the high BMI is associated with depressed mood only among younger (ages 12-14) but not older adolescents,[11] and others that depressive symptoms are more commonly found only among chronically obese boys.[14] Studies on the relationship between BMI and anxiety disorders among adolescents have also produced mixed results. One study found that adolescents with high BMI were less likely to develop generalized anxiety disorder dur-

ing early adulthood,[29] whereas another study found no such relationship for BMI measured in early adulthood and symptoms of anxiety 10 years later.[31] We do not know whether our null finding for mood and anxiety disorders reflects cultural differences between Mexican adolescents and the adolescents in other studies, a possibility suggested by findings that the relationship between BMI and psychiatric disorders among adolescents depends on background ethnicity.[17]

Our study can not determine causation or whether extremes in BMI preceded, followed or developed contemporaneous with the impulse control disorders with which they are related in cross section. Studies can be found that are consistent with all of these possibilities. For example, some studies have found that changes in corporal weight and body development during adolescence have been associated with changes in levels of testosterone and subsequent changes in aggressive behavior,[33] whereas other studies have found that conduct disorder during adolescence predicts subsequent changes in BMI during early adulthood.[30]

Our findings must be considered in light of several additional study limitations. Our study was limited to adolescents living in one of the largest metropolitan areas in the world, but results may not be generalized to other urban or rural areas of Mexico. In addition, our household survey excluded youth who are institutionalized or living in the streets, both populations known to have a high prevalence of mental disorders.[34] The diagnostic instrument used did not include an assessment of all of the DSM-IV disorders, such as schizophrenia and other non-affective psychoses, some of which may be related to BMI, and diagnostic classifications were based on only one informant, namely, the adolescent.[35] Furthermore, although the WMH-CIDI-A was adapted from the adult version WMH-CIDI 3.0 used in Mexico and validated in other Spanish-speaking countries,[23,24] the reliability and validity of the adolescent version used in this survey has not yet been established in Mexico, and some misclassification of cases is therefore possible. BMI was derived from self-reported height and weight and this has been found to result in underestimates of the prevalence of obesity,[36] though this underestimate has not been shown to bear any relation to mental illness. In addition, we lack data about body weight perceptions and body weight satisfaction, which has been proposed as a possible mediator of the BMI mental illness relationship in other studies.[12] The 71% response rate is similar to those of other surveys of this type. The response rates of the World Mental Health Surveys vary from 45.9% to 87.7%.[37] Non-responders were more likely to be older

and male, and thus the data were weighted by sex and age, but we do not know how non-responders might have differed from those who participated in terms of BMI or presence of a psychiatric disorder.

Lastly, this repor is based on cross-sectional information and no directionality or causality can be assumed from these results.

Despite these limitations, the current study adds to the literature on BMI and psychiatric illness among adolescents by examining a wide range of specific psychiatric diagnoses in relation to BMI while simultaneously controlling for several putative confounders, including tobacco use, diet, exercise, demographics and comorbid psychiatric disorders. The modest association we report between low BMI and impulse control disorders among male and female adolescents and between high BMI and impulse control disorders among females need to be explored in different adolescent populations and in larger studies. Future work should aim to collect additional information that may be relevant to better understanding the possible mechanisms linking BMI and psychopathology, such as body weight perception, body image satisfaction, and the timing of changes in BMI and the onset and duration of mental illness in adolescents.

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